

REPORT AND RECOMMENDATIONS
of
PROVINCIAL OFFICER
for
INCO LIMITED OPERATIONS
in the
REGIONAL MUNICIPALITY OF SUDBURY

July 1980



Ministry
of the
Environment

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REPORT AND RECOMMENDATIONS OF PROVINCIAL OFFICER

MADE UNDER SECTION 83

of

THE ENVIRONMENTAL PROTECTION ACT, 1971

for the

INCO LIMITED

COPPER CLIFF SMELTER COMPLEX

IRON ORE RECOVERY PLANT COMPLEX

AND THE

NICKEL REFINERY

in the

REGIONAL MUNICIPALITY OF SUDBURY

JULY, 1980

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1.0 INTRODUCTION

A survey of the Copper Cliff Smelter Complex, the Iron Ore Recovery Plant Complex and the Copper Cliff Nickel Refinery, owned and operated by Inco Limited was conducted during 1977 and 1978. This survey resulted in the issuance of a Control Order, a Requirement and Direction, and a Provincial Officer Requirement in July of 1978.

Since issuance of the control program in 1978, a number of major pieces of information have been made available. A partial bibliography is attached as Schedule I. This information has been evaluated on an ongoing basis as it became available.

Based on this continuing review, and the overall provincial commitment to reduce sulphur dioxide emissions in order to alleviate damage from long range transport of air pollutants, it is believed that there is a need to formally evaluate the current control program requirements. This survey is being conducted to identify and evaluate abatement program needs in light of current information.

2.0 PLANT OPERATION DATA

The locations, sources and nature of emissions and detailed process descriptions for each of the three plants noted, were described in detail in the Ministry of the Environment report, dated June 21, 1978, entitled "Report and Recommendations of Provincial Officer for Inco Limited Operations in the Regional Municipality of Sudbury".

Since then, process change likely to affect the environment has been slight. Processing rates have fluctuated and there have been a few changes, including:

- (1) the installation and operation of electrostatic precipitators treating gases emitted from the Nickel Refinery top blown rotary converters via the flue system to the Iron Ore Recovery Plant, 637' chimney;
- (2) temporary cessation of operation of the two sinter machines in the pellet building at the Iron Ore Recovery Plant Complex;
- (3) continuing field test studies on the use of tonnage oxygen on the reverberatory furnace operation at the Copper Cliff Smelter Complex;

- (4) continuing field testing on supplementary hooding arrangements for the converter operation at the Copper Cliff Smelter Complex;
- (5) formalization of the sulphur dioxide ground level emission control program designed to achieve compliance with the current Order requirements.

3.0 ISSUES

3.1 COPPER CLIFF SMELTER COMPLEX

The Inco Limited Copper Cliff Smelter Complex is a series of processing units designed to eliminate iron, sulphur and other impurities from nickel and copper concentrate feed materials, producing a variety of intermediate products for further processing, and finished products for market. Emissions from the Copper Cliff Smelter Complex can generally be classified for discussion purposes as either 1250' chimney emissions, or low level emissions, which include all other emissions from the smelter. Each of these sources results in emission of sulphur dioxide and particulate matter to the natural environment.

3.1.1 Atmospheric Transport and Deposition

The Copper Cliff Smelter Complex in Sudbury is one of the largest point sources of sulphur dioxide in the world, and at present, with production levels of about 2500 short tons per day, accounts for approximately 3% of all the sulphur dioxide emissions in North America and about 50% of Ontario emissions. Also emitted are sulphuric acid and metals such as copper, nickel, iron, lead, zinc, arsenic and cadmium in particulate form. Most of the sulphur pollutants emanate from Inco's 1250' chimney. Low level emissions make up an appreciable amount of the total emitted particulate matter.

Depending on the prevailing meteorological conditions, emissions may be removed by wet and dry deposition processes at varying distances from Sudbury which range from the immediate locality to many hundreds of kilometres.

After entering the atmosphere, some of the emitted sulphur dioxide is converted to sulphuric acid and other forms of sulphates. The chemical transformation rate of sulphur dioxide to sulphates in the atmosphere has been extensively studied, and rates varying from near zero to over 30% per hour have been reported.

Studies relating to the Inco 1250' chimney plume have been carried out during non-precipitation conditions, and the sulphur dioxide transformation rate was found to be relatively low, about 1% per hour or less. The plume particulate sulphur was found to be mostly in the form of sulphuric acid, and usually made up less than 10% of the total plume sulphur within about 100 kilometres of the Copper Cliff Smelter Complex. There is some evidence to indicate that sulphur dioxide transformation rates during precipitation conditions may be appreciably higher. This in turn could lead to a much larger amount of sulphur dioxide being converted to sulphates (mostly acid sulphate) at locations close to Sudbury.

As the plume travels downwind from the source, dry deposition of both gaseous and particulate matter occurs when these materials come in contact with the earth's surface. The rate of dry deposition of gases and particles depends on the meteorological conditions (primarily wind speed and atmospheric stability) as well as the nature of the surface and the particle size distribution. Low level emissions are particularly susceptible to dry deposition processes, but even tall stack plumes can be brought to ground level fairly frequently by large-scale atmospheric turbulence during the summer months. The dry deposition rate of sulphur dioxide has been found to be greater (sometimes by an order of magnitude) than that for sulphates.

Wet deposition consists of rainout (within-cloud scavenging) and washout (below-cloud scavenging). Particulate wet deposition rates also depend on particle size, as well as the type and intensity of precipitation. For gases such as sulphur dioxide, wet removal rates have generally been found to be lower than those for particles and are complicated by the fact that reversible processes are possible. For example, sulphur dioxide can be absorbed by droplets falling through a plume, and subsequently desorbed by the "cleaner" air below the plume.

Under stable atmospheric conditions, plumes from tall stacks such as that at Sudbury may travel in a coherent form over long distances. These conditions are most common in the fall and winter.

This outline of atmospheric transport, transformation, and deposition illustrates why the phenomenon of acidic deposition is the subject of local, regional, and international concern. This phenomenon is one which is causing widespread impact over distances of thousands of kilometres in North America and Europe. Because of this scale, new approaches to documenting the damage have been developed. National-scale monitoring networks such as CANSAP, NADP, NC-141, SURE, and MAP3S show that wet and dry deposition of acidic compounds is severe. Mathematical modelling of the long range transport of these pollutants indicates which sources of pollution are affecting particular regions of Ontario, Canada and the North American continent.

In the Sudbury area, atmospheric deposition of acids, sulphur compounds, metals and various other substances associated with the local smelting activities has been monitored by several networks. The earliest efforts consisted of bulk deposition measurements. Bulk deposition is carried out using collectors continuously open to the atmosphere, which collect both wet deposition and an unknown fraction of dry deposition. More recently, attempts have also been made to quantify wet and dry deposition rates separately. To date, several reports and papers have been published which conclude the following:

1. During rainstorms, most particulate constituents of the smelter emissions (acids, sulphates, metals) are removed quite efficiently from the atmosphere in contrast to the removal of sulphur dioxide.
2. The relative contribution of smelter emissions (during August - September 1978 and June - September 1979) to the total wet deposition of acids, sulphur and metals (other than copper and nickel) in the Sudbury area is in the order of 10 to 20% depending on the weather, with the relative contribution being greater for cold-frontal storms. For copper and nickel, the smelter contribution is much higher, making up roughly 40% of the total wet deposition.

3. Bulk deposition measurements, which have a dry deposition contribution, support the wet deposition results. Efficient particulate removal from the atmosphere is indicated by the rapid decrease of copper and nickel bulk deposition with distance from Sudbury. The contribution of smelting operations to the deposition of copper and nickel in the Sudbury area is also shown by the marked decrease in the bulk deposition of these metals during the Inco shutdown period in 1978 and 1979.
4. The contribution of Sudbury smelting activities farther afield (such as in the Muskoka-Haliburton area) is less than in the Sudbury area.

3.1.2 Aquatic Effects

Precambrian rock and the associated soils have low buffering capacity, so the surface waters in such areas can be acidified by atmospheric sources of acids. Precambrian rock covers a large area of Northern Ontario. The thousands of lakes in this area are rich in aquatic life and are the resource base for a recreational industry worth hundreds of millions of dollars per year.

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Acidification of lakes has been documented in the Sudbury area with some 140 of 209 lakes surveyed having pH values too low to support healthy fish populations. Lake acidification has contributed to the extinction of the aurora trout (subspecies of brook trout) in its only known natural range (Whitepine, Whirligig and Wilderness Lakes in the greater Sudbury area).

Lakes in the Sudbury area are subjected to heavy loadings of copper and nickel from the atmosphere. The concentration in lakes within 50 kilometres of Sudbury are elevated and in combination with low pH contribute to the toxicity of the water.

Evidence of declining buffering capacity of soils has been reported for the Muskoka-Haliburton area. Current acid loadings in the area cause depressed pH conditions in the spring runoff. In some streams the pH of the spring runoff is low enough to cause damage to aquatic life although the pH during the rest of the year may not cause problems.

Acidic precipitation also leaches the watersheds at an accelerated rate particularly with respect to some metals such as aluminum and manganese. Some lakes in the Sudbury area have aluminum concentrations of from 280 to 380 micrograms per litre which can contribute to fish toxicity in combination with low pH.

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Fish in acid-stressed lakes, i.e. those with low pH in the spring and/or reduced pH during the summer, tend to have higher mercury concentrations posing potential problems for the sport fishing industry and wildlife.

Three acidic lakes near Sudbury were neutralized with a mixture of lime and limestone over the period 1973 to 1975. These lakes have demonstrated that the current acid loadings in the area are capable of acidifying lakes since their pH values have been declining since neutralization took place. In addition, metal concentrations remained toxic even after the pH was adjusted to near neutral, so that the fisheries could not be re-established.

Available techniques for the measurement of the input of materials by deposition from the atmosphere underestimate the particulate and gaseous components. Using other methodologies, it is apparent that the input of acids in the Sudbury area is about double that measured in bulk deposition collectors. Calculations using accurate mass balance data collected at Clearwater Lake demonstrate that the actual sulphur input from the atmosphere is about twice that collected by bulk collectors. An acid-base balance on Nelson Lake watersheds indicates that the actual acid input is about twice that obtained by deposition measurements. The acid accumulated in snow cores at Middle Lake is also about twice the sum of the individual precipitation measurements of acid during the winter.

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Any and all reductions in acid loadings to the Precambrian lakes in Ontario will contribute to a reduced rate of acidification, reduced severity of the spring pH depression, reduced leaching of aluminum from the watershed, a longer time period for less sensitive lakes to be seriously impaired and less tendency toward elevated mercury concentrations in fish.

3.1.3 Terrestrial Effects

Various monitoring programs, employing air, snow, soil and vegetation sampling and analysis, indicate that there has been historical deposition of numerous metals in the area around the Inco Limited Copper Cliff Smelter Complex. The deposition of metals has, in conjunction with low soil pH, sulphur dioxide injury and erosion, contributed to losses of vegetation in the Sudbury area. In order to revegetate barren and semi-barren areas, it has been necessary to add lime to soils in order to increase the pH and to render the deposited metals unavailable to subsequently established vegetation.

High volume sampling in the Sudbury area has shown that the levels of nickel and copper are considerably higher than in most other areas in the Province, even

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though the levels comply with the criteria in Ontario Regulation 872/74. Inco Limited's contribution to these elevated levels was dramatically demonstrated by the marked decrease in nickel and copper in suspended particulates during the recent 9-month labour strike. Furthermore, dustfall and bulk deposition measurements exhibited similar trends during the shutdown period.

Although the Provincial air quality criteria are being met, there is a continuing chronic level of deposition of metals associated with the Copper Cliff Smelter Complex. This deposition is in addition to the acute loadings which were deposited in the 50-75 years prior to 1970. This historic deposition of metals is supported by sediment data from lakes in the Sudbury area.

The present day chronic loading accentuates vegetation problems due to the acute historic accumulation.

3.1.4 Related Studies

The current environmental impact of the Copper Cliff Smelter Complex can be reduced through construction of more sophisticated pollution abatement facilities, reduced smelter throughput, or altered process

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configuration. In this regard, Inco Limited has notified the Ministry of the Environment through correspondence, statements and press releases that they are studying:

1. supplementary hooding arrangements for the converter facilities;
2. pyrrhotite rejection as a means of reducing sulphur dioxide emissions;
3. tonnage oxygen utilization on reverberatory furnaces;
4. dual hooding arrangements for the converter facilities;
5. new smelting technologies.

Insufficient data are available on these studies to allow an overall environmental impact assessment. If the Ministry is to be kept abreast of the potential environmental significance of these ongoing studies, information will have to be submitted to the Ministry by Inco Limited at each major phase of each study.

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3.1.5 Low Level Emission Data

Low level emissions from the Copper Cliff Smelter Complex include all emissions not exhausted to the natural environment by the 1250' chimney. Major contributors are believed to include converter vents, matte tunnel ventilators, matte pouring/slag skimming ventilators, and building vents serving the reverberatory furnaces, roasters and copper flash furnace. In keeping with the terms of the current control program, Inco Limited have submitted three reports:

1. "MONITORING OF FUGITIVE EMISSIONS OF SO₂ PARTICULATES IN NO. 15 COPPER CONVERTER VENTILATOR", dated June 1, 1978;
2. "Monitoring of fugitive emissions of sulphur, particulate and acid mist in #4 converter roof ventilator (progress report)", dated November 9, 1979;
3. "Measurement of fugitive emissions of sulphur dioxide, particulates and sulphuric acid from nickel reverberatory furnaces", dated March 19, 1980.

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3.1.6 1250' Chimney Emissions Data

The 1250' chimney receives process off-gases from the nickel converter circuit (including the roasters, reverberatory furnaces and converters), the copper concentrate circuit (including the copper flash furnace and converters) and the matte processing circuit. In all cases these gases are treated in electrostatic precipitators before being discharged to the natural environment.

Emission characteristics for the 1250' chimney are summarized in Schedule III for sulphur dioxide and particulate matter. These tables are based on mass balance information and stack testing information. With reference to these tables, it may be seen that sulphur dioxide emissions (including the low level fraction which is estimated at less than 5% of the total emissions), have decreased from a high of approximately 5500 tons per day in 1960 (on an annual basis) to 1172 tons per day in 1979 (on an annual

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basis). This latter emission rate is low due to an extended strike. Actual current emission levels on a monthly basis are approximately 2500 tons per day. Reductions in large part, have been achieved through increased pyrrhotite rejection and reduced production levels, in accordance with previous Ministry Orders.

Particulate matter emissions have also been reduced from a high of approximately 200 tons per day to a current level of about 25 tons per day. These reductions have been achieved through improved process gas treatment and reduced production levels.

3.1.7 Ground Level Sulphur Dioxide Concentration Control

At present, sulphur dioxide emissions are limited on a tonnage basis to 3600 tons per day (annual average) and are regulated, dependent on meteorological conditions, to achieve compliance with a maximum hourly average ground level concentration of 0.5 ppm due to the 1250' chimney, either alone or in combination with other Inco Limited sources.

Inco Limited has maintained compliance with the sulphur dioxide tonnage restrictions in the current Control Order and except for one incident in 1978, which is

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before the Courts at this time, has maintained compliance with the ground level concentration requirement for sulphur dioxide as specified in the Control Order. However, experience with the emission control program since formal adoption in 1978 has provided a clearer understanding of the program and established a need for upgrading with respect to data collection and information transfer in order to ensure continued acceptable operation.

Specific upgrading measures include:

3.1.7.1 Meteorological Data Collection

The current Order calls for temperature lapse rate determination which is accomplished by one balloon release each morning. Hence, measured information is not available on wind speed or direction at any level greater than 300 m (CKSO tower anemometer). This early morning balloon release should be tracked to provide wind speed and direction in addition to the temperature lapse rate. This information will play a role in the prediction of the magnitude of ground level concentrations and is extremely useful in determining deployment of mobile monitoring equipment.

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To provide additional information as the day progresses, the release of two additional tracked balloons is required. The balloons, which must be released fifteen minutes apart, two hours before the mixed layer height is forecast to reach plume level, will verify the early morning forecast and allow for adjustments in the forecast to ensure compliance with the Order.

In addition to teletype and Alden map recorder data, additional information is available from the Atmospheric Environment Service of Environment Canada by telephoning the meteorologist on duty at Toronto International Airport. This serves to provide the system operator with updated forecast information and hence, permits a more accurate interpretation of the data.

3.1.7.2 Emission Data Collection

The current in-stack sulphur dioxide emission monitoring system is subject to malfunction and scheduled maintenance, both of which result in loss of system availability. These data are critical to the continued acceptable operation of the emission reduction program and could be made

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available on a more continuous basis with a duplicate back-up monitoring system. Both the primary and the back-up system could be accommodated through the existing data handling system.

3.1.7.3 Ground Level Sulphur Dioxide Data Collection

The mobile monitor, a vehicle equipped with a continuous sulphur dioxide gas analyzer, provides a feedback link for evaluating the control action and therefore, a means of improving the predictive capability of the model. This mobile monitor is subject to malfunction and scheduled maintenance. Provision of a second mobile monitor will improve overall feedback and data collection.

3.1.7.4 Model Verification and Improvement

The effectiveness of the ground level sulphur dioxide concentration control program is directly correlated with the accuracy of the model used to predict ground level concentrations. Hence, an annual evaluation of this model is necessary to ensure that all reasonable steps are being taken to maintain optimum operation of the system in keeping with developing modelling technology.

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3.2 COPPER CLIFF NICKEL REFINERY

The Copper Cliff Nickel Refinery, located southwest of the Copper Cliff Smelter Complex, is designed to produce nickel powders and nickel pellets using the Inco Pressure Carbonyl Process.

Emissions from the plant are exhausted to atmosphere via a flue system and the Iron Ore Recovery Plant Complex 637' chimney and via building stacks and vents. Collectively, the latter are referred to as low level emissions.

The current Control Order required the installation of additional gas treatment facilities to treat exhaust gases from the top blown rotary converters, discharged via the flue system to the Iron Ore Recovery Plant chimney, by March 31, 1980. These facilities were installed, are operating and are currently being evaluated for compliance with The Environmental Protection Act, 1971. This evaluation will provide a data base for determining the need for further action.

The current control program also required Inco Limited to submit a report by December 31, 1979, evaluating the quantity and significance of low level emissions exhausted from the Copper Cliff Nickel Refinery. This

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The current control program also required Inco Limited to submit a report by December 31, 1979, evaluating the quantity and significance of low level emissions exhausted from the Copper Cliff Nickel Refinery. This

report, submitted under letter dated December 21, 1979, confirmed the existence of high ground level concentrations of nickel due to low level emissions and hence, confirmed the need for further abatement of these emissions, to comply with The Environmental Protection Act, 1971 and Regulations thereunder.

In evaluating the data presented in the report noted above, it is significant that approximately 50% of the total measured emissions are related to building vents over the top blown rotary converters, which have no control devices. The remainder is exhausted from controlled sources such as baghouses and scrubbers. It is important, therefore, that the control program address both the treatment of uncontrolled sources and the efficiency of existing controls on controlled sources, if the Ministry is to be assured of the continued acceptability of the pollution control facilities at the Copper Cliff Nickel Refinery.

3.3 IRON ORE RECOVERY PLANT COMPLEX

The Iron Ore Recovery Plant Complex, located southwest of the Copper Cliff Smelter Complex, receives pyrrhotite concentrate feed from the Copper Cliff concentrator. It is capable of producing a variety of

report, submitted under letter dated December 21, 1979, confirmed the existence of high ground level concentrations of nickel due to low level emissions and hence, confirmed the need for further abatement of these emissions, to comply with The Environmental Protection Act, 1971 and Regulations thereunder.

In evaluating the data presented in the report noted above, it is significant that approximately 50% of the total measured emissions are related to building vents over the top blown rotary converters, which have no control devices. The remainder is exhausted from controlled sources such as baghouses and scrubbers. It is important, therefore, that the control program address both the treatment of uncontrolled sources and the efficiency of existing controls on controlled sources, if the Ministry is to be assured of the continued acceptability of the pollution control facilities at the Copper Cliff Nickel Refinery.

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The Iron Ore Recovery Plant Complex, located southwest of the Copper Cliff Smelter Complex, receives pyrrhotite concentrate feed from the Copper Cliff concentrator. It is capable of producing a variety of

products, including iron pellets, nickel products and intermediate products, in a series of steps including roasting, kiln reduction, leaching, leach recovery and pelletizing.

Emissions of sulphur dioxide from the Iron Ore Recovery Plant 637' chimney include C.I.L. acid plant tail gases, Copper Cliff Nickel Refinery top blown rotary converter flue gases, kiln gases and roaster by-pass gases. These emissions are controlled under the current Control Order to a maximum of 250 tons per day on an annual average basis and are further controlled dependent on varying dispersion conditions, to achieve compliance with an hourly average ground level concentration requirement of 0.25 ppm.

Compliance has been maintained with the tonnage limitation requirement; however, insufficient information is available to evaluate either the methodology of controlling ground level concentrations or the effectiveness of the program.

With reference to effectiveness of control, the current ground level concentration monitoring network (fixed and mobile monitoring) needs to be assessed and redesigned. It is understood that Inco Limited has

products, including iron pellets, nickel products and intermediate products, in a series of steps including roasting, kiln reduction, leaching, leach recovery and pelletizing.

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With reference to effectiveness of control, the current ground level concentration monitoring network (fixed and mobile monitoring) needs to be assessed and redesigned. It is understood that Inco Limited has

collected some mobile monitoring data which may be of assistance in upgrading the monitoring system.

The control system is understood to be similar in nature to that currently employed for the Copper Cliff Smelter Complex with a modified dispersion model calculation procedure. The details of the system must be provided, along with daily reporting (plan and log) if the Ministry is to be satisfied with the system.

4.0 FINDINGS

As a result of this survey of the Copper Cliff Smelter Complex, Iron Ore Recovery Plant Complex, and Nickel Refinery, owned and operated by Inco Limited in the Regional Municipality of Sudbury, the following findings are ascribed:

4.1 Copper Cliff Smelter Complex

- 4.1.1 Emissions of sulphur dioxide from the Copper Cliff Smelter Complex's 1250' chimney contribute significantly to acid loadings in Ontario lakes, many of which are already heavily loaded with acid,

collected some mobile monitoring data which may be of assistance in upgrading the monitoring system.

The control system is understood to be similar in nature to that currently employed for the Copper Cliff Smelter Complex with a modified dispersion model calculation procedure. The details of the system must be provided, along with daily reporting (plan and log) if the Ministry is to be satisfied with the system.

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4.1 Copper Cliff Smelter Complex

- 4.1.1 Emissions of sulphur dioxide from the Copper Cliff Smelter Complex's 1250' chimney contribute significantly to acid loadings in Ontario lakes, many of which are already heavily loaded with acid,

thus threatening the viability of such lakes as a suitable habitat for fish and other aquatic life or inhibiting the potential for recovery of any such lakes which have already become toxic. In addition, these sulphur dioxide emissions are a significant portion of continental North American sulphur dioxide emissions, which have caused and continue to cause continent-wide problems from acid rain and the gradual acidification of lakes.

- 4.1.2 Information currently available, provides the basis for taking immediate steps to reduce sulphur dioxide emissions.
- 4.1.3 Insufficient information is available on studies currently being undertaken by Inco Limited to define the consequences of alternatives potentially available to mitigate environmental impact. This information is required to make future decisions on environmental control.

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4.1.2 Information currently available, provides the basis for taking immediate steps to reduce sulphur dioxide emissions.

4.1.3 Insufficient information is available on studies currently being undertaken by Inco Limited to define the consequences of alternatives potentially available to mitigate environmental impact. This information is required to make future decisions on environmental control.

4.1.4 Information available on low level emissions from the Copper Cliff Smelter Complex indicates that substantial amounts of contaminants are being emitted to the natural environment, which may result in contravention of The Environmental Protection Act, 1971 and Regulations thereunder.

4.1.5 Upgrading of the Copper Cliff Smelter Complex ground level sulphur dioxide concentration control system is required with respect to data collection and model evaluation if the Ministry is to be assured of the optimum operation of the system.

4.2 Copper Cliff Nickel Refinery

4.2.1 Emissions of nickel, in free and combined form, from the sources collectively known as low level emissions, on occasion exceeds the maximum permissible concentration prescribed by Regulation 15 under The Environmental Protection Act, 1971.

4.1.4 Information available on low level emissions from the Copper Cliff Smelter Complex indicates that substantial amounts of contaminants are being emitted to the natural environment, which may result in contravention of The Environmental Protection Act, 1971 and Regulations thereunder.

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4.2 Copper Cliff Nickel Refinery

4.2.1 Emissions of nickel, in free and combined form, from the sources collectively known as low level emissions, on occasion exceeds the maximum permissible concentration prescribed by Regulation 15 under The Environmental Protection Act, 1971.

4.2.2 Due to the potential variability in efficiency of control and the potential magnitude of emissions from low level sources which currently have pollution control facilities, a continuing testing program is required to ensure the continued acceptability of these facilities.

4.3 Iron Ore Recovery Plant Complex

4.3.1 Insufficient measurement data are available to determine whether sulphur dioxide emitted from the 637' chimney, result in hourly average ground level concentrations in excess of 0.25 ppm, as required in the current Order.

4.3.2 Insufficient information is available to the Ministry on either the methodology or effectiveness of the program for controlling ground level concentrations of sulphur dioxide due to emissions from the 637' chimney.

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4.3.2 Insufficient information is available to the Ministry on either the methodology or effectiveness of the program for controlling ground level concentrations of sulphur dioxide due to emissions from the 637' chimney.

5.0 RECOMMENDATIONS

It is recommended that Inco Limited be issued a Control Order under Section 6 of The Environmental Protection Act, and a Provincial Officer Requirement, under Section 84 of The Environmental Protection Act, as follows:

CONTROL ORDER

1. a) Immediately take such steps as are necessary so that emissions of sulphur dioxide into the natural environment:
 - i) from the Copper Cliff Smelter Complex shall not exceed 2500 short tons per working day based on a computation at the end of each quarter,
 - a) for the period from the date this Order becomes enforceable to June 30, 1981, by taking the total emissions from the date this Order becomes enforceable to the respective last days of September and December 1980 and March and June 1981, divided by the number of working days in each such period,

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 - a) for the period from the date this Order becomes enforceable to June 30, 1981, by taking the total emissions from the date this Order becomes enforceable to the respective last days of September and December 1980 and March and June 1981, divided by the number of working days in each such period,

- b) thereafter by taking, at the end of each calendar quarter, the total emissions for the preceding twelve month period divided by the number of working days in that period;
- ii) from the Copper Cliff Smelter 1250' chimney either alone or in combination with other Inco Limited Sudbury emissions do not result in a measured hourly average ground level concentration in excess of 0.5 ppm and do not result in a measured 24 hour average ground level concentration in excess of 0.15 ppm.
- b) Have in place and operate a comprehensive sulphur dioxide ground level concentration control system for the Copper Cliff Smelter Complex designed to achieve compliance with paragraph 1(a)(ii). The system shall include prediction, control and data handling capability and shall include at least the items noted in Appendix I which shall be in operation on or before the dates indicated therein. Information will be provided on the control system by:
 - i) continuing to provide the Director forthwith any amendments to the most recent operations manual;

- b) thereafter by taking, at the end of each calendar quarter, the total emissions for the preceding twelve month period divided by the number of working days in that period;
 - ii) from the Copper Cliff Smelter 1250' chimney either alone or in combination with other Inco Limited Sudbury emissions do not result in a measured hourly average ground level concentration in excess of 0.5 ppm and do not result in a measured 24 hour average ground level concentration in excess of 0.15 ppm.
- b) Have in place and operate a comprehensive sulphur dioxide ground level concentration control system for the Copper Cliff Smelter Complex designed to achieve compliance with paragraph 1(a)(ii). The system shall include prediction, control and data handling capability and shall include at least the items noted in Appendix I which shall be in operation on or before the dates indicated therein. Information will be provided on the control system by:
- i) continuing to provide the Director forthwith any amendments to the most recent operations manual;

- ii) providing the Director or his staff each day with a plan, prior to 8:30 a.m., for implementation of the system for the next 24 hours and provide forthwith any amendments to the plan;
 - iii) providing the Director or his staff within 32 hours of the end of the period, a log recording the operation of the system for the 24 hour period referred to in the paragraph above.
- c) File with the Director, within 45 days of the end of each calendar quarter, a written summary of the aggregate emissions of sulphur dioxide from the Copper Cliff Smelter Complex for such period, with supporting data sufficient to enable verification of the emissions.
2. a) Take such steps as are necessary so that emissions of sulphur dioxide into the natural environment:
- i) from the Iron Ore Recovery Plant Complex, in the aggregate, shall not exceed 250 short tons per working day based on a computation at the end of each quarter,

- ii) providing the Director or his staff each day with a plan, prior to 8:30 a.m., for implementation of the system for the next 24 hours and provide forthwith any amendments to the plan;
 - iii) providing the Director or his staff within 32 hours of the end of the period, a log recording the operation of the system for the 24 hour period referred to in the paragraph above.
- c) File with the Director, within 45 days of the end of each calendar quarter, a written summary of the aggregate emissions of sulphur dioxide from the Copper Cliff Smelter Complex for such period, with supporting data sufficient to enable verification of the emissions.
2. a) Take such steps as are necessary so that emissions of sulphur dioxide into the natural environment:
- i) from the Iron Ore Recovery Plant Complex, in the aggregate, shall not exceed 250 short tons per working day based on a computation at the end of each quarter,

- a) for the period from the date this Order becomes enforceable to June 30, 1981, by taking the total emissions from the date this Order becomes enforceable to the respective last days of September and December 1980 and March and June 1981, divided by the number of working days in each such period,
 - b) thereafter by taking, at the end of each calendar quarter, the total emissions for the preceding twelve month period divided by the number of working days in that period;
- ii) from the Iron Ore Recovery Plant Complex, do not result in a measured hourly average ground level concentration in excess of 0.25 ppm.
- b) Have in place and operate a comprehensive sulphur dioxide ground level concentration control system for the Iron Ore Recovery Plant Complex designed to achieve compliance with paragraph 2(a)(ii). The system shall include prediction, control and data handling capability and shall include at least the items noted in Appendix II which shall be in operation on or before the dates indicated therein. Information will be provided on the control system by:

- a) for the period from the date this Order becomes enforceable to June 30, 1981, by taking the total emissions from the date this Order becomes enforceable to the respective last days of September and December 1980 and March and June 1981, divided by the number of working days in each such period,
 - b) thereafter by taking, at the end of each calendar quarter, the total emissions for the preceding twelve month period divided by the number of working days in that period;
- ii) from the Iron Ore Recovery Plant Complex, do not result in a measured hourly average ground level concentration in excess of 0.25 ppm.
- b) Have in place and operate a comprehensive sulphur dioxide ground level concentration control system for the Iron Ore Recovery Plant Complex designed to achieve compliance with paragraph 2(a)(ii). The system shall include prediction, control and data handling capability and shall include at least the items noted in Appendix II which shall be in operation on or before the dates indicated therein. Information will be provided on the control system by:

- i) providing immediately to the Director a true copy of an operations manual, or an addendum to the operations manual noted in paragraph 1(b) describing the procedures for operation of the system and providing to the Director forthwith any amendments to the operations manual or addendum;
 - ii) providing the Director or his staff each day with a plan prior to 8:30 a.m. for implementation of the system for the next 24 hours and providing forthwith any amendments to the plan;
 - iii) providing the Director or his staff within 32 hours of the end of the period, a log recording the operation of the system for the 24 hour period referred to in the paragraph above.
- c) File with the Director, within 45 days of the end of each calendar quarter, a written summary of aggregate emissions from the Iron Ore Recovery Plant Complex for such period, with supporting data sufficient to enable verification of the emissions.

- i) providing immediately to the Director a true copy of an operations manual, or an addendum to the operations manual noted in paragraph 1(b) describing the procedures for operation of the system and providing to the Director forthwith any amendments to the operations manual or addendum;
 - ii) providing the Director or his staff each day with a plan prior to 8:30 a.m. for implementation of the system for the next 24 hours and providing forthwith any amendments to the plan;
 - iii) providing the Director or his staff within 32 hours of the end of the period, a log recording the operation of the system for the 24 hour period referred to in the paragraph above.
- c) File with the Director, within 45 days of the end of each calendar quarter, a written summary of aggregate emissions from the Iron Ore Recovery Plant Complex for such period, with supporting data sufficient to enable verification of the emissions.

3. On or before August 31, 1980, submit a written evaluation of the effectiveness of the electrostatic precipitators treating gases emitted from the Nickel Refinery TBR converters via the flue system to the Iron Ore Recovery Plant Complex, accompanied by an outline of any further action and/or facilities that may be needed to provide compliance with Regulation 15 under The Environmental Protection Act, 1971.
4. a) On or before December 31, 1980, submit a written report to the Director detailing the options available to reduce emissions of sulphur dioxide from the Copper Cliff Smelter Complex to 1950 short tons or less per working day averaged over a twelve month period computed on a running quarterly basis. The options shall include at least the following:
 - i) pyrrhotite rejection or other feed treatment technology;
 - ii) current "Thompson smelting technology" with fixation facilities;
 - iii) flash smelting technology with fixation facilities;
 - iv) flue gas desulphurization by scrubbing or other means;
 - v) any other options deemed appropriate by Inco Limited;
 - vi) any of the above taken in combination.

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 - i) pyrrhotite rejection or other feed treatment technology;
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 - iii) flash smelting technology with fixation facilities;
 - iv) flue gas desulphurization by scrubbing or other means;
 - v) any other options deemed appropriate by Inco Limited;
 - vi) any of the above taken in combination.

For each option considered the following must be addressed in the report in detail:

- 1) Description of facilities and/or operational changes required;
- 2) Reliability of the technology;
- 3) Implementation schedule to achieve completion of construction by December 31, 1982 or earlier;
- 4) An assessment of the ability of the option to achieve compliance with The Environmental Protection Act, 1971 and Regulations thereunder;
- 5) An assessment of how the option enhances or limits potential for future sulphur dioxide emission reduction;
- 6) Capital investment required;
- 7) Operating costs;
- 8) Environmental implications;
- 9) Socioeconomic implications.

The report shall conclude with a comparison and evaluation of all of the options and shall select the option to be implemented.

- b) On or before December 31, 1982, complete any installation or construction necessary for implementation of the selected option.

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- 1) Description of facilities and/or operational changes required;
- 2) Reliability of the technology;
- 3) Implementation schedule to achieve completion of construction by December 31, 1982 or earlier;
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- 5) An assessment of how the option enhances or limits potential for future sulphur dioxide emission reduction;
- 6) Capital investment required;
- 7) Operating costs;
- 8) Environmental implications;
- 9) Socioeconomic implications.

The report shall conclude with a comparison and evaluation of all of the options and shall select the option to be implemented.

- b) On or before December 31, 1982, complete any installation or construction necessary for implementation of the selected option.

- c) Immediately after completion of required installation or construction, proceed with operation of the selected option.
 - d) By June 30, 1983 submit a written report which reviews the operation of the selected option and demonstrates that the selected option has been made fully operational and optimized to achieve the greatest reduction of sulphur dioxide emissions from the Copper Cliff Smelter Complex.
5. a) On or before December 31, 1980, investigate and report to the Director in writing on a method of control designed to bring all low level emissions from the Nickel Refinery, as detailed in your report dated December 17, 1979, into compliance with the standards set out in Regulation 15 under The Environmental Protection Act, 1971.
- b) On or before December 31, 1982, complete the installation, construction or arrangement and have in operation the facilities referred to in paragraph 5(a).
- c) On or before June 30, 1983, submit a written evaluation report on the efficiency of the facilities noted in paragraph 5(a) accompanied by

- c) Immediately after completion of required installation or construction, proceed with operation of the selected option.
 - d) By June 30, 1983 submit a written report which reviews the operation of the selected option and demonstrates that the selected option has been made fully operational and optimized to achieve the greatest reduction of sulphur dioxide emissions from the Copper Cliff Smelter Complex.
5. a) On or before December 31, 1980, investigate and report to the Director in writing on a method of control designed to bring all low level emissions from the Nickel Refinery, as detailed in your report dated December 17, 1979, into compliance with the standards set out in Regulation 15 under The Environmental Protection Act, 1971.
- b) On or before December 31, 1982, complete the installation, construction or arrangement and have in operation the facilities referred to in paragraph 5(a).
- c) On or before June 30, 1983 submit a written evaluation report on the efficiency of the facilities noted in paragraph 5(a) accompanied by

an outline of any further action and/or facilities that may be needed to provide compliance with Regulation 15 and Ontario Regulation 872/74 under The Environmental Protection Act, 1971.

6. For the purpose of this Control Order, the term "working day", will include all days during each and every year except any calendar day when none of the processing units in the complex at any time during the day receives sulphur bearing process feed material which results in any sulphur dioxide emissions to the atmosphere.

an outline of any further action and/or facilities that may be needed to provide compliance with Regulation 15 and Ontario Regulation 872/74 under The Environmental Protection Act, 1971.

6. For the purpose of this Control Order, the term "working day", will include all days during each and every year except any calendar day when none of the processing units in the complex at any time during the day receives sulphur bearing process feed material which results in any sulphur dioxide emissions to the atmosphere.

APPENDIX I

Copper Cliff Smelter Complex Emission Reduction Program

The ground level sulphur dioxide concentration control system shall have as a minimum:

1. The following items or equivalent when the Control Order comes into effect.

Meteorological Data Collection

- * a) Anemometers on the CKSO tower at the 3 and 300 metre levels.
- * b) Temperature sensors at the 3, 30 and 300 metre levels on the CKSO tower.
- * c) A telemetering system to transmit the signals from the units on the CKSO tower to the computer facilities in the Engineering Building.
- * d) Minisonde equipment to determine temperature lapse rates twice per day, one for the early morning forecast and the second two hours before the mixed layer height is estimated to reach plume level.
- * e) A teletype and Alden map recorder to receive meteorological data as supplied by the Federal Government Atmospheric Environment Service.

Emission Data Collection

- a) Dual temperature thermocouples in the 1250' chimney.
- b) A velocity sensor in the 1250' chimney.
- c) A sulphur dioxide sample collection/analysis system for the 1250' chimney emissions.
- d) A telemetering system to transmit the signals from the instruments in the 1250' chimney to the computer facilities in the Engineering Building.

Ground Level Sulphur Dioxide Data Collection

- * a) Mobile monitor with communication system and sulphur dioxide analyser.
- * b) Not less than 4 fixed telemetered sulphur dioxide monitoring stations. Two of the stations will be at Chelmsford and Little Round Lake.

Data Handling

- * a) A computer facility to receive, store and handle sensor signal inputs.
- * b) A video terminal (with keyboard) and a computer remote terminal (with keyboard printer) with multiple access to run the dispersion model.

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Copper Cliff Smelter Complex Emission Reduction Program

The ground level sulphur dioxide concentration control system shall have as a minimum:

1. The following items or equivalent when the Control Order comes into effect.

Meteorological Data Collection

- * a) Anemometers on the CKSO tower at the 3 and 300 metre levels.
- * b) Temperature sensors at the 3, 30 and 300 metre levels on the CKSO tower.
- * c) A telemetering system to transmit the signals from the units on the CKSO tower to the computer facilities in the Engineering Building.
- * d) Minisonde equipment to determine temperature lapse rates twice per day, one for the early morning forecast and the second two hours before the mixed layer height is estimated to reach plume level.
- * e) A teletype and Alden map recorder to receive meteorological data as supplied by the Federal Government Atmospheric Environment Service.

Emission Data Collection

- a) Dual temperature thermocouples in the 1250' chimney.
- b) A velocity sensor in the 1250' chimney.
- c) A sulphur dioxide sample collection/analysis system for the 1250' chimney emissions.
- d) A telemetering system to transmit the signals from the instruments in the 1250' chimney to the computer facilities in the Engineering Building.

Ground Level Sulphur Dioxide Data Collection

- * a) Mobile monitor with communication system and sulphur dioxide analyser.
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Data Handling

- * a) A computer facility to receive, store and handle sensor signal inputs.
- * b) A video terminal (with keyboard) and a computer remote terminal (with keyboard printer) with multiple access to run the dispersion model.

2. The following facilities in place and operating within four months of the date when this Order becomes effective:

Meteorological Data Collection

- * Theodolite equipment and balloons to determine wind speed and direction three times per day, one for the early morning forecast and the second two releases 15 minutes apart two hours before the mixed layer height is estimated to reach plume level.

Emission Data Collection

Two complete independent sulphur dioxide emission monitoring systems for the 1250' chimney, each with temperature, velocity and sulphur dioxide concentration measurement instruments.

Ground Level Sulphur Dioxide Data Collection

- * Two mobile monitors, each with a communication system and sulphur dioxide analyser.

Note:

Those items denoted with an asterisk are taken to be common to both Appendix I and Appendix II.

2. The following facilities in place and operating within four months of the date when this Order becomes effective:

Meteorological Data Collection

- * Theodolite equipment and balloons to determine wind speed and direction three times per day, one for the early morning forecast and the second two releases 15 minutes apart two hours before the mixed layer height is estimated to reach plume level.

Emission Data Collection

Two complete independent sulphur dioxide emission monitoring systems for the 1250' chimney, each with temperature, velocity and sulphur dioxide concentration measurement instruments.

Ground Level Sulphur Dioxide Data Collection

- * Two mobile monitors, each with a communication system and sulphur dioxide analyser.

Note:

Those items denoted with an asterisk are taken to be common to both Appendix I and Appendix II.

APPENDIX II

Iron Ore Recovery Plant Complex Emission Reduction Program

The ground level sulphur dioxide concentration control system shall have as a minimum:

1. The following items or equivalent when the Control Order comes into effect.

Meteorological Data Collection

- * a) Anemometers on the CKSO tower at the 3 and 300 metre levels.
- * b) Temperature sensors at the 3, 30 and 300 metre levels on the CKSO tower.
- * c) A telemetering system to transmit the signals from the units on the CKSO tower to the computer facilities in the Engineering Building.
- * d) Minisonde equipment to determine temperature lapse rates twice per day, one for the early morning forecast and the second two hours before the mixed layer height is estimated to reach plume level.
- * e) A teletype and Alden map recorder to receive meteorological data as supplied by the Federal Government Atmospheric Environment Service.

Ground Level Sulphur Dioxide Data Collection

- * a) Mobile monitor with communication system and sulphur dioxide analyser.
- * b) Not less than 4 fixed telemetered sulphur dioxide monitoring stations. Two of the stations will be at Chelmsford and Little Round Lake.

Data Handling

- * a) A computer facility to receive, store and handle sensor signal inputs.
- * b) A video terminal (with keyboard) and a computer remote terminal (with keyboard printer) with multiple access to run the dispersion model.

2. The following facilities in place and operating within four months of the date when this Order becomes effective:

Meteorological Data Collection

- * Theodolite equipment and balloons to determine wind speed and direction three times per day, one for the early morning forecast and the second two releases 15 minutes apart two hours before the mixed layer height is estimated to reach plume level.

APPENDIX II

Iron Ore Recovery Plant Complex Emission Reduction Program

The ground level sulphur dioxide concentration control system shall have as a minimum:

1. The following items or equivalent when the Control Order comes into effect.

Meteorological Data Collection

- * a) Anemometers on the CKSO tower at the 3 and 300 metre levels.
- * b) Temperature sensors at the 3, 30 and 300 metre levels on the CKSO tower.
- * c) A telemetering system to transmit the signals from the units on the CKSO tower to the computer facilities in the Engineering Building.
- * d) Minisonde equipment to determine temperature lapse rates twice per day, one for the early morning forecast and the second two hours before the mixed layer height is estimated to reach plume level.
- * e) A teletype and Alden map recorder to receive meteorological data as supplied by the Federal Government Atmospheric Environment Service.

Ground Level Sulphur Dioxide Data Collection

- * a) Mobile monitor with communication system and sulphur dioxide analyser.
- * b) Not less than 4 fixed telemetered sulphur dioxide monitoring stations. Two of the stations will be at Chelmsford and Little Round Lake.

Data Handling

- * a) A computer facility to receive, store and handle sensor signal inputs.
- * b) A video terminal (with keyboard) and a computer remote terminal (with keyboard printer) with multiple access to run the dispersion model.

2. The following facilities in place and operating within four months of the date when this Order becomes effective:

Meteorological Data Collection

- * Theodolite equipment and balloons to determine wind speed and direction three times per day, one for the early morning forecast and the second two releases 15 minutes apart two hours before the mixed layer height is estimated to reach plume level.

Emission Data Collection

A sulphur dioxide emission monitoring system for the 637' chimney or equivalent monitoring capability. The equivalent capability must include determination of sulphur dioxide emissions contributed by each of the process streams exhausting to the 637' chimney on a real time basis (hourly average).

Ground Level Sulphur Dioxide Data Collection

- * Two mobile monitors, each with a communication system and sulphur dioxide analyser.

Note:

Those items denoted with an asterisk are taken to be common to both Appendix I and Appendix II.

Emission Data Collection

A sulphur dioxide emission monitoring system for the 637' chimney or equivalent monitoring capability. The equivalent capability must include determination of sulphur dioxide emissions contributed by each of the process streams exhausting to the 637' chimney on a real time basis (hourly average).

Ground Level Sulphur Dioxide Data Collection

- * Two mobile monitors, each with a communication system and sulphur dioxide analyser.

Note:

Those items denoted with an asterisk are taken to be common to both Appendix I and Appendix II.

PROVINCIAL OFFICER REQUIREMENT

1. Submit written reports on the on-going smelting technology evaluations noted in the Inco Metals Company Media Information Release dated February 8, 1980 as follows:
 - i) An overview of the process units and the metallurgy of the proposed technology by September 30, 1980;
 - ii) A technical critique based on the Port Colborne pilot testing program by December 31, 1980;
 - iii) A technical critique based on the Thompson, Manitoba commercial scale test by June 30, 1981;
 - iv) A technical/economic assessment based on pilot plant work and other information available to Inco Limited by December 31, 1981. This report must address both the applicability of this technology to the Inco Limited Copper Cliff Smelter Complex in the Regional Municipality of Sudbury, and the ability of this technology in combination with other facilities to reduce sulphur dioxide emissions to 225 short tons or less per working day, averaged over a twelve month period, computed on a running quarterly basis, and in particular, must include:

PROVINCIAL OFFICER REQUIREMENT

1. Submit written reports on the on-going smelting technology evaluations noted in the Inco Metals Company Media Information Release dated February 8, 1980 as follows:
 - i) An overview of the process units and the metallurgy of the proposed technology by September 30, 1980;
 - ii) A technical critique based on the Port Colborne pilot testing program by December 31, 1980;
 - iii) A technical critique based on the Thompson, Manitoba commercial scale test by June 30, 1981;
 - iv) A technical/economic assessment based on pilot plant work and other information available to Inco Limited by December 31, 1981. This report must address both the applicability of this technology to the Inco Limited Copper Cliff Smelter Complex in the Regional Municipality of Sudbury, and the ability of this technology in combination with other facilities to reduce sulphur dioxide emissions to 225 short tons or less per working day, averaged over a twelve month period, computed on a running quarterly basis, and in particular, must include:

- a) Description of facilities and/or operational changes required;
 - b) Reliability of technology;
 - c) Critical path implementation schedule to achieve completion of facilities and/or operational changes in the shortest possible time;
 - d) An assessment of the ability of this technology to achieve compliance with The Environmental Protection Act, 1971 and Regulations thereunder;
 - e) Capital investment required;
 - f) Operating costs;
 - g) Environmental implications;
 - h) Socioeconomic implications.
2. Submit a written report by December 31, 1980 on the investigations being undertaken by Inco Limited on water-cooled hood technology and supplementary outer hood technology. This report must address the effectiveness of each hooding system relative to both fugitive emission control and process gas strength.
3. Conduct emission tests at the Copper Cliff Smelter Complex as required to quantify low level emissions of sulphur dioxide and particulate matter (including sufficient elemental analysis to characterize composition) that result from the operation of the roasters and copper flash furnace and submit a report in writing on the above by December 31, 1980.

- a) Description of facilities and/or operational changes required;
 - b) Reliability of technology;
 - c) Critical path implementation schedule to achieve completion of facilities and/or operational changes in the shortest possible time;
 - d) An assessment of the ability of this technology to achieve compliance with The Environmental Protection Act, 1971 and Regulations thereunder;
 - e) Capital investment required;
 - f) Operating costs;
 - g) Environmental implications;
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2. Submit a written report by December 31, 1980 on the investigations being undertaken by Inco Limited on water-cooled hood technology and supplementary outer hood technology. This report must address the effectiveness of each hooding system relative to both fugitive emission control and process gas strength.
3. Conduct emission tests at the Copper Cliff Smelter Complex as required to quantify low level emissions of sulphur dioxide and particulate matter (including sufficient elemental analysis to characterize composition) that result from the operation of the roasters and copper flash furnace and submit a report in writing on the above by December 31, 1980.

4. Carry out an investigation and submit a written report by December 31, 1981 evaluating the options for controlling low level emissions from the Copper Cliff Smelter Complex as required to achieve compliance with The Environmental Protection Act, 1971 and Regulations thereunder.

For each option considered the following must be addressed in the report in detail:

- i) Description of facilities and/or operational changes required;
- ii) Reliability of technology;
- iii) Critical path implementation schedule to achieve completion of facilities in the shortest possible time;
- iv) An assessment of how the option enhances or limits potential for future emission reductions;
- v) Capital investment required;
- vi) Operating costs;
- vii) Environmental implications;
- viii) Socioeconomic implications;

The report shall conclude with a comparison and evaluation of all the options and shall select the best option.

4. Carry out an investigation and submit a written report by December 31, 1981 evaluating the options for controlling low level emissions from the Copper Cliff Smelter Complex as required to achieve compliance with The Environmental Protection Act, 1971 and Regulations thereunder.

For each option considered the following must be addressed in the report in detail:

- i) Description of facilities and/or operational changes required;
- ii) Reliability of technology;
- iii) Critical path implementation schedule to achieve completion of facilities in the shortest possible time;
- iv) An assessment of how the option enhances or limits potential for future emission reductions;
- v) Capital investment required;
- vi) Operating costs;
- vii) Environmental implications;
- viii) Socioeconomic implications;

The report shall conclude with a comparison and evaluation of all the options and shall select the best option.

5. Conduct emission tests and submit a report in writing evaluating the significance, nature and quantity of particulate and ferric oxide emissions from the No. 1 sinter machine exhaust stack at the Iron Ore Recovery Plant within 9 months of start-up of this sinter machine.
6. Conduct emission tests on all low level vented process emissions which are sources of nickel, but not including normal building ventilation exhausts, from the Copper Cliff Nickel Refinery on a quarterly basis and submit written quarterly reports within 90 days of the end of each calendar quarter and a written annual report summarizing the testing data within 90 days of the end of each calendar year.
7. Within 90 days of the end of each calendar year submit a written report to the Director, which tests the validity of the Inco Limited air quality simulation models utilized in the emission reduction program, with respect to monitored sulphur dioxide levels in the Sudbury area. With respect to the same monitored data, the report also shall test the validity of all other models provided by the Director at least 15 months in advance of the reporting date. The report shall compare the validity of the models.

5. Conduct emission tests and submit a report in writing evaluating the significance, nature and quantity of particulate and ferric oxide emissions from the No. 1 sinter machine exhaust stack at the Iron Ore Recovery Plant within 9 months of start-up of this sinter machine.
6. Conduct emission tests on all low level vented process emissions which are sources of nickel, but not including normal building ventilation exhausts, from the Copper Cliff Nickel Refinery on a quarterly basis and submit written quarterly reports within 90 days of the end of each calendar quarter and a written annual report summarizing the testing data within 90 days of the end of each calendar year.
7. Within 90 days of the end of each calendar year submit a written report to the Director, which tests the validity of the Inco Limited air quality simulation models utilized in the emission reduction program, with respect to monitored sulphur dioxide levels in the Sudbury area. With respect to the same monitored data, the report also shall test the validity of all other models provided by the Director at least 15 months in advance of the reporting date. The report shall compare the validity of the models.

8. Submit a written report by December 31, 1980 on how well the existing Inco Limited fixed and mobile ground level sulphur dioxide concentration monitoring program characterizes the impact of the Iron Ore Recovery Plant Complex emissions on air quality. This report must be based on meteorological data, emission dispersion characteristics and ground level concentrations of sulphur dioxide measurements. The report shall make recommendations for improving the existing monitoring program.
9. Within 9 months of receiving concurrence from the Director for the optimized system resulting from item 8, begin providing ground level concentration monitoring data from this system in the quarterly environmental reports to the Director.

Prepared by:

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L. W. Fitz,
Provincial Officer.

8. Submit a written report by December 31, 1980 on how well the existing Inco Limited fixed and mobile ground level sulphur dioxide concentration monitoring program characterizes the impact of the Iron Ore Recovery Plant Complex emissions on air quality. This report must be based on meteorological data, emission dispersion characteristics and ground level concentrations of sulphur dioxide measurements. The report shall make recommendations for improving the existing monitoring program.
9. Within 9 months of receiving concurrence from the Director for the optimized system resulting from item 8, begin providing ground level concentration monitoring data from this system in the quarterly environmental reports to the Director.

Prepared by:

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SCHEDULE II

Copper Cliff Smelter ComplexEstimates of Fugitive Emissions⁽¹⁾

<u>Unit</u>	<u>SO² Ton/Day</u>	<u>Particulate Ton/Day</u>	<u>Copper Ton/Day</u>	<u>Nickel Ton/Day</u>
Copper ⁽²⁾ Converters	11.7-41.7	1.1-3.8	.6-2.0	-
Nickel ⁽³⁾ Converters	.4-6.7	.2	<.1	<.1
Reverberatory Furnaces	15.5 ⁺ 20%	.2	-	-
Roasters		Work not completed		
Copper Flash Furnace		Work not completed		
Estimated Total based on available information	~28-64	1.5-4.2	.6-2.0	u/k

- Note:
1. Emission estimates based on 1100 T/D bessemer matte and 440 T/D blister copper
 2. Based on good hood and bad hood emissions
 3. Based on maximum error limits of + 90%
 4. Emission estimates based on Inco Limited reports

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SCHEDULE IIIAverage EmissionsCopper Cliff Smelter - 1250' Chimney

<u>Particulate</u>		<u>Sulphur Dioxide</u>	
<u>Year</u>	<u>T/D</u>	<u>Year</u>	<u>T/D</u>
1967	200	1960	5496
1970	125	1970	4620
1971	145	1971	4114
1972	110	1972	3707
1973	45	1973	3263
1975	25	1974	3448
Current	25	1975	3493
		1976	3540
		1977	3213
		1978	1638
		1979	1172

- Note:
1. SO₂ emissions include low level
 2. SO₂ emissions averaged over calander year
 3. Current particulate emissions based on 1979-80 in-stack work.

Current Monthly EmissionsCopper Cliff Smelter

<u>Month</u>	<u>1979 T/D</u>	<u>Month</u>	<u>1980 T/D</u>
Sept.	2556	Jan.	2584
Oct.	2410	Feb.	2623
Nov.	2320	Mar.	2532
Dec.	2138	Apr.	2281

References:

1. Inco Metals Company Environmental Control Report submitted under letter dated April 11, 1980.
2. Inco Limited Sulphur Emission Abatement Program dated July 5, 1976.
3. Internal Communication with Air Resources Branch.
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